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Watershed Restoration Class – Spring, 2003

Pájaro River Watershed Flood Protection Plan

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Executive Summary

Because of the unique geologic and hydrologic setting of the Pájaro River in its dynamic watershed, traditional approaches to flood control may not be effective and will require constant expensive maintenance. The river that now flows through it did not create the lower Pájaro Valley and it is not possible to “restore” such a system to stability because there is no evidence of any past stable Pájaro River channel in the lower valley. An artificial flood control channel was constructed by early residents and was upgraded by the U.S. Army, and later by the Corps’ of Engineers to try to minimize property losses associated with large floods in this watershed of about 1300 square miles. Historically the Pájaro watershed system has carried runoff from Santa Clara, San Benito, Santa Cruz, and Monterey counties into Monterey Bay through various channels in Monterey County. The river is now artificially confined to join Corralitos Creek to enter the ocean along the Santa Cruz/Monterey County border.

We find that a substantial area of on-channel storage of floodwater has been lost in the upper watershed areas of San Benito and Santa Clara counties. Some of this lost storage can be recovered for little or no public cost to reduce flood heights (on the order of 4 feet) in the artificial floodway channel of the lower river. Redesign of that lower channel may accommodate added flood capacity to provide a working flood channel that carries a generously estimated 100-year flood volume. Such redesign, coupled with upstream channel restoration that is part of a flood storage enhancement project, will have very substantial wildlife and water quality habitat benefits.

Table of Contents

FIGURES AND PLATES

APPENDICES

Pájaro River Watershed Flood Management Alternatives

A study by the CSUMB Watershed Restoration Class, Spring 2003

CHAPTER 1

Introductory Context

This report is a group effort of 12 upper level students who have focused much of their education on Watershed Science through the Earth Systems Science and Policy Program at California State University Monterey Bay. Some participants had already graduated from CSUMB or UC Santa Cruz; while most were finishing seniors with educations that included advanced hydrology, water law, and riparian ecology. CSU Monterey Bay stresses an "outcomes-based" education with active, applied learning. This work is not financially supported, but a small anonymous donation of $500 helped with copying and telephone costs. The Santa Clara Valley group "People for Livable and Affordable Neighborhoods" supported a detailed watershed map made especially for this effort by Eureka Cartography in Berkeley. San Benito County and the Graniterock Company contributed map and data resources.

This report follows the theme of our educational program and treats the Pájaro Watershed as a physical and biological system. We take the position that it is not possible to isolate the processes and problems in the lower watershed from the causal mechanisms in the upper watershed. We look at the watershed as a complete system with material and energy flows that support living ecosystems and organisms. We assess the causes of dysfunction, which in this particular case focuses on responses of humans to flooding and sediment transport, and evaluate potential solutions utilizing fundamentals of fluvial geomorphology and restoration ecology.

This particular study was undertaken in the context of significant fundamental disagreements between residents, agencies, and government entities. Following the California Supreme Court finding that upheld lower court's rulings against County governments for causing flooding in 1995 through lack of required maintenance, Monterey and Santa Cruz counties requested that the U.S. Army Corps of Engineers consider a new flood control project to protect the downstream areas from 100-year return-period floods. This class effort focused on the opportunities to reduce downstream flood hazards through upstream flood detention and through design of a stable channel alternative in the artificially constrained lower reaches of what is called the Pájaro Valley.

The Corps' had been requested to evaluate protection options for only the lower river system working with only the lower county governments, and further constrained by limited budgets and the necessity to work with a set of "stakeholders" who represented diverse and often contradictory viewpoints. With this impossible set of constraints, landowner, environmental, and agency views that had seemed in conflict with each other soon refocused on conflict with the Corps' themselves, who ultimately were left to represent only the county governments who had brought them into the project.

This report is now presented simultaneously with the Corps of Engineers flood control proposals and with a citizens' sponsored and funded set of alternative flood protection solutions produced by the renown hydrologic consulting firm of Philip Williams Associates. It is hoped that this university effort can help to expand the very limited scope of the many other ongoing and recent studies to create viable alternatives in this very complex watershed system.

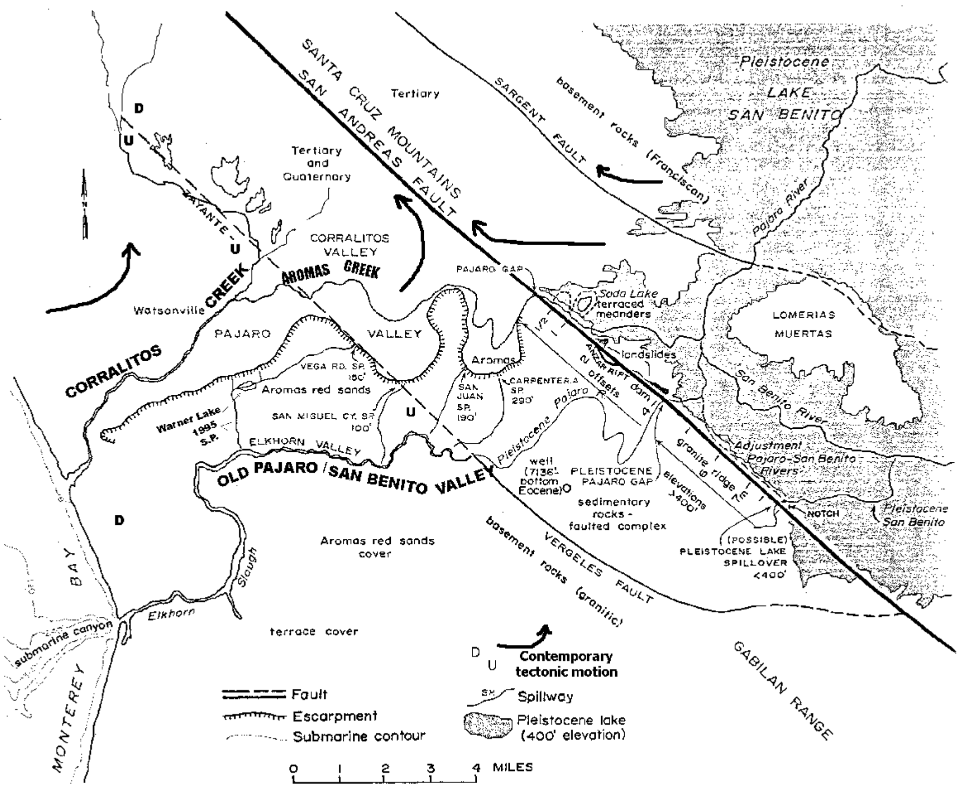
The Pájaro Watershed System Dynamics

The Watershed: At present the Pájaro River watershed drains an area of approximately 1300 square miles. The watershed primarily drains the counties of San Benito, and Santa Clara, with some added contribution from Santa Cruz County. Very small areas of Fresno and Monterey counties are also within the watershed but contribute very little to the runoff. About 91 percent of the watershed is in North America while the outlet in the Lower Pájaro Valley and the Corralitos and Watsonville Slough tributaries are on the Pacific Plate. Due to active faulting within the watershed boundaries, the rivers' coarse is continuously changing and has not stabilized in a valley of its own construction. The San Benito River is now 51% of the entire Pájaro drainage area but contributes only about 25% of the runoff at Chittenden (an average of 49 ac-ft/an/sq.mi.) The Pájaro above the San Benito junction (at Sargent) contributes about 180 ac-ft/an/sq.mi from 39% of the basin. Corralitos/Salsipuedes tributary is only about 3% of the watershed but contributes on the order of 435 ac-ft/sq.mi, or nearly 10% of the total discharge of the Pájaro system. Constructed reservoirs have a maximum capacity of 42,680 ac-ft (Hernandez:18,500; Uvas:9950; Chesbro:8090; and Pacheco:6140). We estimate that about 60,000 ac-ft of near-channel flood storage also exists in areas that are subject to overbank or in-channel flood storage or were 50 years ago. About 24,000 ac-ft of lost storage can be readily restored at little or no public cost.

A map of the watershed that incorporates the detailed findings of this report is available on-line in a medium-resolution 10 MB and low resolution 700 KB version at http://home.csumb.edu/c/currybob/world/Pajaro/ where this report itself and some of its graphics is also available. This watershed map utilizes the existing left-bank levee of the lower river as the watershed divide between Elkhorn Slough and the Pájaro watersheds.

Lower Watershed, Santa Cruz and Monterey Counties: The Pájaro Watershed is unusual. Traditional engineering solutions must accommodate the unique geology and hydrologic character of the basin. The headwaters of the basin are in North America but the primary plate boundary represented by the Calavaras and San Andreas Fault zones separates the mouth of the present river from its historic source areas. Active transform faulting has repeatedly and progressively modified the course of the river that today bears the name Pájaro. The unusual shape of the watershed itself, with a long source area far south of the outlet is the result of continual stretching of the watershed by active faulting that pulls the lower river northwestward, farther and farther from its headwaters.

Much of the lower river, west of the San Andreas Fault Zone, does not flow in a valley of its own making. The original course of Corralitos Creek in Santa Cruz County (see Fig. 1) and its alluvial aquifer have now been taken over by the Pájaro River system. The ancestral Pájaro River has been repeatedly offset northward by right-lateral fault offset, sometimes emptying to the coast through Elkhorn Slough at Moss Landing, and other times commingling with Corralitos Creek as it does today. California's State Geologist, Olaf Jenkins (1973) postulated that landslides near Chittenden Gap, forming Lake San Benito and later Lake San Juan that repeatedly spilled and scoured overflow channels in the Carneros Creek/Elkhorn Slough area, might have repeatedly dammed the main river. Even today, during flood stage, the lower river flows to the sea at Moss Landing. Jenkins reasoned that these changes are geologically contemporary, having occurred in the last few thousand to 20,000 years at the most. Fundamental evidence for the very young character of this lake and its overflow is the fact that the lake shorelines are evidently not evidently tilted or deformed, despite being astride two active faults, and finding that the lake sediments contain a fully contemporary local flora and fauna.



CAPTURE OF PAJARO / SAN BENITO RIVER BY CORRALITOS CREEK

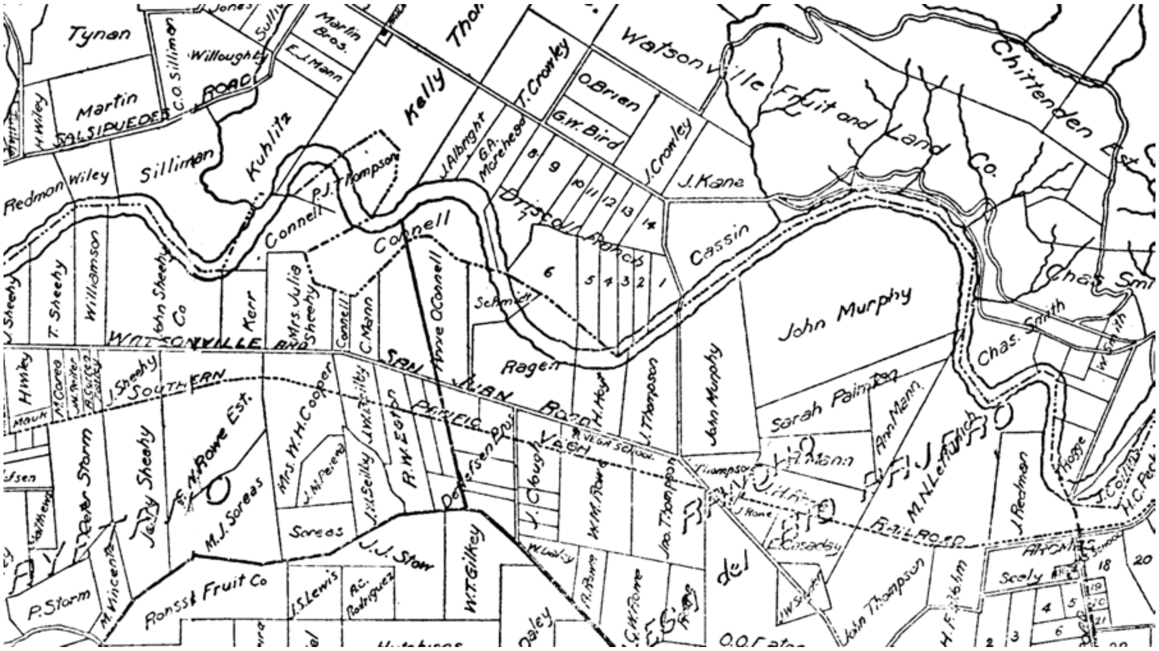
Modified after Olaf Jenkins, 1973, *California Geology*, p. 154

Fig 1

Figure 1 represents a slight modification of the original Jenkins map (Curry, 1996) with a series of name changes to better reflect the geologic evolution of the present lower Pájaro River as it spilled through Chittenden Gap to overwhelm any preexisting local watercourses. It is critical to appreciate that Corralitos Creek and its presumed tributary Aromas Creek did not capture the Pájaro River, but instead a great lake dammed by faulting and/or landslides spilled catastrophically into what we now call the Pájaro Valley. This explains the lack of terraces and floodplain deposits in the lower Pájaro Valley, and the massive Lake San Benito silts that now blanket the lower valley to support its agriculture.

Because the river that now flows through it did not form the lower Pájaro Valley, the watercourse is inherently unstable. Fluvial geomorphology recognizes this condition as “overfit”, with the natural watercourse being too big for its channel. Coupled to this inherent instability is the fact that the lower Pájaro Valley is traversed by the San Andreas Fault and the subsidiary Zayante-Vergeles fault system (R. Anderson, 1990). These are all among the most active terrestrial fault systems on the North American continent. The 1989 Loma Prieta earthquake apparently deformed the Pájaro River levee system (personal survey notes). Today the lowest point in the Pájaro Valley is not the Pájaro River but is a small overflow watercourse along the extreme south side of the lower valley. Based on undercutting of the hillsides at the south edge of the present Pájaro Valley and preserved cutoff meanders there, the southernmost edge of the valley has been the lowest point for at least several hundred to several thousand years (see Fig. 2).

It is thus perplexing that the present river course and levee system coincide with the lower Corralitos Creek channel. Based on the early maps made shortly after statehood in 1850 and local place names, a grazing wetland commons existed in the Mexican Ranchero period in the area still known as the Vega (see Map A, Rancho Vega del Rio Pájaro, Map B). The vega meadows here were apparently flood irrigated regularly to constrain land use and thus provided a grazing Mexican land grant until Statehood and private (Porter) ownership. The Vega is adjacent to a spot on the original river (see Map A) where the river was straightened after the boundary between Santa Cruz and Monterey counties was established (California Historical Survey, 1923). An alluvial thalweg (central river channel) is now buried beneath the levee system and has been the locus of flood outbreaks from at least the 1930s through 1995 (see Fig 3). All of the positions of today’s levees crossing the 1854 channel position are sites of piping and passage of river water under the levees during high water as seen in 1995 and 1998 (personal observation, R. Curry and landowner discussions).



Map B. 1908 Parcel Map of a portion of the Lower Pájaro Valley showing the historic Vega area and dot-dashed County boundary as it exists today.

Figure 2 -- 1939 Photo of Lower Pájaro Valley. Watsonville in lower right. The landslides are readily seen at the position of Highway 1 today, near the center left of the photo. Also visible are the flow lines from past floods that impinge against the left (south) side of the valley.

Map A 1875 based on 1854 land survey

It may be that in the Ranchero and early statehood period, the lower Pájaro River was channelized to try to restrict regular overbank flow in distributary channels so that land use could be made more efficient. Looking at the 1939 and earlier aerial photos, we still see clear evidence of those distributaries (cf Fig. 3). The earliest detailed topographic map (Capitola Quadrangle, 1912) shows “Watsonville Creek” that flows from the left bank of the Pájaro River across that river from Salsipuedes Creek in Watsonville, directly south near Salinas Road and into Elkhorn Slough. That channel is still there and still carries rainfall and flood overflow runoff to Moss Landing. Runoff from a major part of the townsite of Pájaro does not enter the Pájaro River today but flows via “Watsonville Creek” to Elkhorn Slough. The confusing topography was commented on by William Brewer in his diary in 1864 that noted that the flat valley looked like "an old lake filled in as is shown by the terraces around its sides." (Farquhar, 1930). Olaf Jenkins identifies a “Lake Pájaro” and “Lake Aromitas” in the old lower Pájaro Valley (1973).

Figure 3 - 1938 Image of Lower Pájaro River showing natural meander patterns

Upper Watershed, San Benito and Santa Clara Counties: The upper watershed of the Pájaro system is at least as complex as that of the portion west of the San Andreas Fault. There is indirect geologic evidence that Santa Clara Valley from San Jose southward through Morgan Hill and Gilroy may have been the course of a major river carrying coarse gravels southward toward the present Pájaro River and that a lake in San Benito County later spilled northward along Coyote Valley into San Francisco Bay (Iwamura, 1995). An open and porous alluvial gravel characterizes the near surface substrate beneath both the north-flowing Coyote Creek and the south-flowing Llagas and Uvas Creek valleys. A very low gradient "watershed divide" near Morgan Hill has southward flow in a shallow subsurface aquifer, presumably recharged by Santa Clara Water District facilities from California Water Project sources (Anderson Reservoir) and from locally captured and diverted watercourses. Where this shallow gravel aquifer is exposed in the bank of the Pájaro River, along the westernmost Santa Clara -- San Benito County border, many cubic feet per second of water flow continuously into the Pájaro River. These high water tables were recognized long before the San Luis Project brought Mt. Shasta water into southern Santa Clara and northern San Benito counties. The high groundwater levels are recognized as a particular agricultural problem in San Benito County (Jones & Stokes, 1998) where some are saline.

The thick uniform silt deposits of Northern San Benito and Southern Santa Clara counties are themselves enigmatic (see Fig 5 from Jenkins). Jenkins refers to them as "Pleistocene" meaning of Pleistocene age (greater than 10,000 years ago) and draws parallels with glacial age origin silts. Indeed, the surface deposits of lakebed silts are remarkably uniform fine sandy silt similar to glacial origin rock flour in both texture and lack of chemical weathering. But calling upon an ancestral San Joaquin River system to deposit these silts from the Sierra Nevada is, at present, not demonstrated. Jenkins hypothesizes that the silts may be derived locally from the older Purisima Formation (locally now called the Etchegoin Formation east of the San Andreas Fault). Subsurface deposits of northern San Benito County are characterized by localized sands and gravels that appear to be river deposits embedded in silts formed in shallow ephemeral lakes (Stanley, et al, 2002; Jones & Stokes, 1998). These are then buried by the more uniform overlying silt lakebeds. It is these surface lake silt unit(s) that have been transported downstream to blanket the lower Pájaro River Valley. It is not clear that they are being eroded from agricultural fields upstream, and may simply be carried in flood flows from upstream bank erosion.

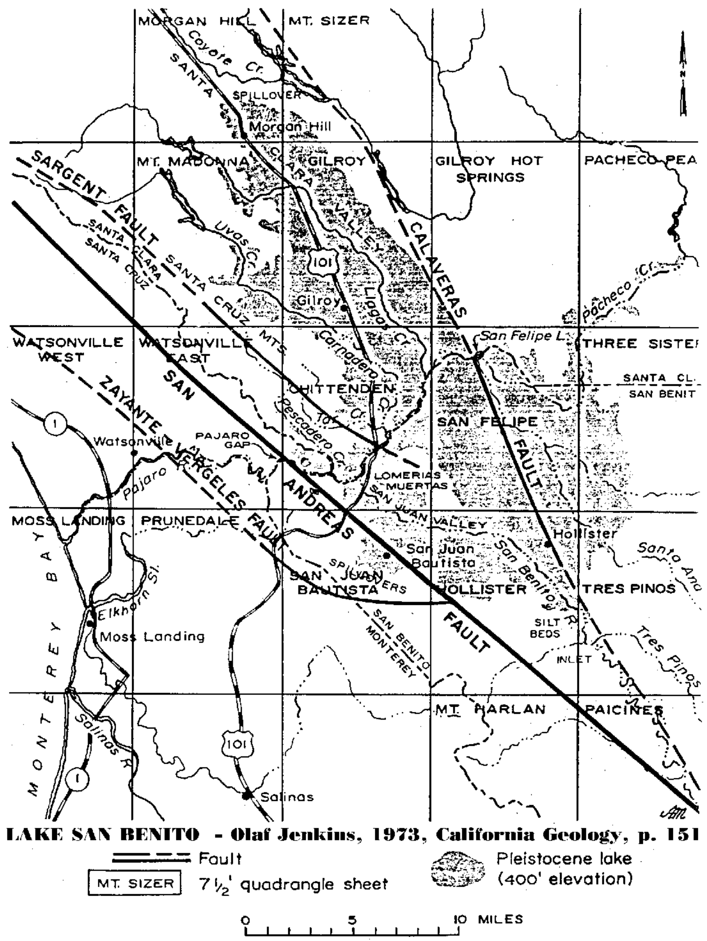


Figure 5 Jenkin's map Lake San Benito with its tectonic setting

The Calavaras, San Andreas, and Sargent fault zones define much of the course of the present tributaries of the upper Pájaro River system. These right-lateral strike-slip plate-bounding fault systems essentially lengthen the headwaters of the Pájaro River, repeatedly moving the upper river system southward 10's of kilometers relative to the Pacific Plate. The Old San Juan Stage Road between Salinas and San Juan Bautista appears to follow an abandoned course of what is now called the San Benito River after that river was pulled northward on the west side of the faults to join the upper Pájaro River. All of this may have happened during as little as a few hundred or thousand year period of lakes being dammed and spilling before the river ultimately broke through the Chittenden water gap to spill westward rather than southward. It is interesting to note that this rare example of a true water gap in western United States is actually called "Chittenden Pass". A water gap is a pass through a mountain range or ridge cut by water. These are generally found in places like the Appalachians where a very old river is able to keep flowing while mountains are arched upward beneath it or while erosion lowers the river across a buried bedrock feature. Chittenden Pass is indeed a narrow part of the new river valley but cut by catastrophically spilling water.

The River System: No other reasonably large North American river drains a watershed that is as complex or as geologically active as the Pájaro . Only in the

Himalaya and Alaska are there possibly watersheds of greater than 1000 square miles with an equal level of active watercourse displacement and contemporary changes in drainage area, and those rely in part on glaciers to block and divert the faulted landscapes. The Pájaro is unique in that geologic activity must be factored in to an understanding of the dynamics of flood hazard evaluation in a populated area. Ongoing geologic deformation renders constructed features like levees and channels very impermanent. Stream gradients and streambed elevations are changing by feet per century from non-anthropogenic causes (cf, 1906 earthquake and loss of navigability of Elkhorn Slough to the commercial steamer carrying Watsonville cargo to Moss Landing, Loma Prieta earthquake, creep on the Calavaras fault). Traditional approaches to flood hazard mitigation must accommodate this constant change.

Stable Channel Alternatives: Stable channel concepts are almost a tautology in a constantly changing watershed system. But because we have 65 year-old or older aerial photos of almost the entire watershed, we can find evidences of the characteristics of river channels and flood patterns preserved from the time before laser leveling and powerful tractors. Many of the historic areas of lowland flooding and lake silts throughout the watershed were initially farmed as orchards. Uplands were used for hay and barley. The lower Pájaro Valley was noted for its apples and the upper valleys for walnuts (Crosetti, 1993). These seasonal crops were tolerant of winter flooding, seasonal root saturation, and some aggradation. Access to farmlands with mechanized equipment and safety of grazing animals led to efforts to straighten channels and, as elsewhere in the world, to shorten channels and cut off meander loops. The 1854 Coast and Geodetic Survey mapping, later expanded in the 1870's to include more inland areas through the U.S. Lands Office, showed that the Pájaro had been altered by the time of statehood. The 1854 survey, at a scale of 1:10,000, is accompanied by survey notes (Wm. M. Johnson, 1854) that state: "Extending from the mouth of the Pájaro River to the Salinas River is a range of low sand hills between which and the older formation lay several ponds. These mark the former bed of the Pájaro, it having evidently at one time, found its way to the ocean through this channel, but by an accumulation of its waters, during the winter months, it burst the narrow strip of beach which separates it from the sea, and thus formed itself a new more direct outlet". By 1909, the Coast and Geodetic Survey report noted that the Pájaro River "has low but well-defined banks and there is no evidence of recent changes in its course" (1910 C&GS survey notes). Those coastal surveys generally extended only 2.5 miles inland.

Maps of Santa Cruz and of Monterey Counties were prepared in the 1870's and are on file in the University of California Santa Cruz map library (see list in References Cited). An example is shown as Map A. It is important to appreciate that the river plan form shown in these early commercial maps was based on earlier US Land Office plat maps and the Coast and Geodetic surveys. It is the County boundary maps that show accurately the changes in position of the Pájaro River and that must be used for the actual position of the river (California Historical Survey Commission, 1923). Based on that definitive reference, the channel of the Pájaro had been straightened shortly after Statehood and continued to be altered through the late 1800's.

Based on geomorphic understanding of the relationships between a river and its natural floodplain, one can establish a channel geometry that, for a given gradient and sediment load, can approximate the shape of a channel that is self-maintaining (Curry, 1981; Riley, 2003). Of course, the lower Pájaro River does not have a floodplain in the normal sense of a surface of deposition and transportation of sediment and water that exceeds the effective dominant discharge of the river system. The lower Pájaro Valley land surface is a flood-deposit, but not one formed through an equilibrium relationship between its river and its flood regime (see Whiting, 1998). Thus, use of standard hydrologic relationships between flood frequency and magnitude to estimate ideal channel dimensions and form may be limited in applicability. Not only is the river changing in length because of human channel shortening, but also the seaward limit of the river mouth has moved inland many 10's of meters since the first 1854 survey (1910 C&GS survey notes). Further, tectonic deformation may be tilting the whole lower Pájaro Valley and surroundings southward. Still further, changed drainage areas in the upper watershed and incision of watercourses are apparently increasing the ratios of runoff to rainfall.

But use of historic aerial photos to interpret pre-channelization or flood-time flow patterns can provide clues to the "natural" channel form that the Pájaro would take if unconstrained. As pointed out by outside Corps of Engineers project review team members (USCofE, 1998), the current levee-constrained channel may not reflect a stable channel configuration. British work, funded through the US Army Corps of Engineers, has concluded that, as a general rule in sand-bed rivers, the mean annual discharge and the bankfull discharge form lower and upper bounds, respectively, to the range of effective discharge, while the 2-year flow is an upper bound to the range of bankfull discharge (Soares, cite).

Ron Copeland provided a contribution to the Corps' Project Review Team report for the lower Pájaro Project (USCoE, 1998). He suggested that use of a channel-forming dominant discharge with a probability of recurrence of 1.5 to 2.0 years could permit estimation of ideal bankfull width and meander wavelength for a given gradient, roughness, and sediment load regime. That is the same approach as described by Rosgen in his Fig 1 (see next) (Rosgen, 1996). It has real merit. Copeland included Fig 4 from Akers and Charlton, 1970, in his contribution to the Pájaro review team report (figure follows). Using a calculated (Fig 6) discharge for a 2.0-year return period at Chittenden, we calculate that the dominant channel-forming flow that should equate to bankfull discharge in a stable channel is about 3500 cfs. Using that value in the Ackers and Charlton figure yields a stable meander wavelength for a channel unconstrained laterally by levees with a value of 1000 to 1500 feet. That is what we see in the historic overflow channels on the old aerial photos (Fig 4), and in the early historic maps of the river platform. Thus there is a corroboration of theory and systems function in the lower Pájaro River channel, despite the unusual nature of the relationships between the watershed and the areas subject to flooding.

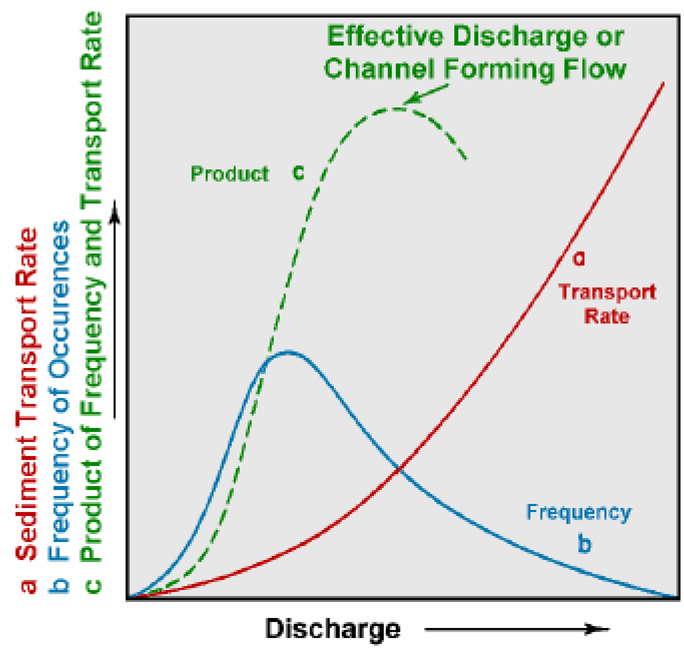


Figure 1: Effective Discharge (from *Applied River Morphology*. 1996. Dave Rosgen)

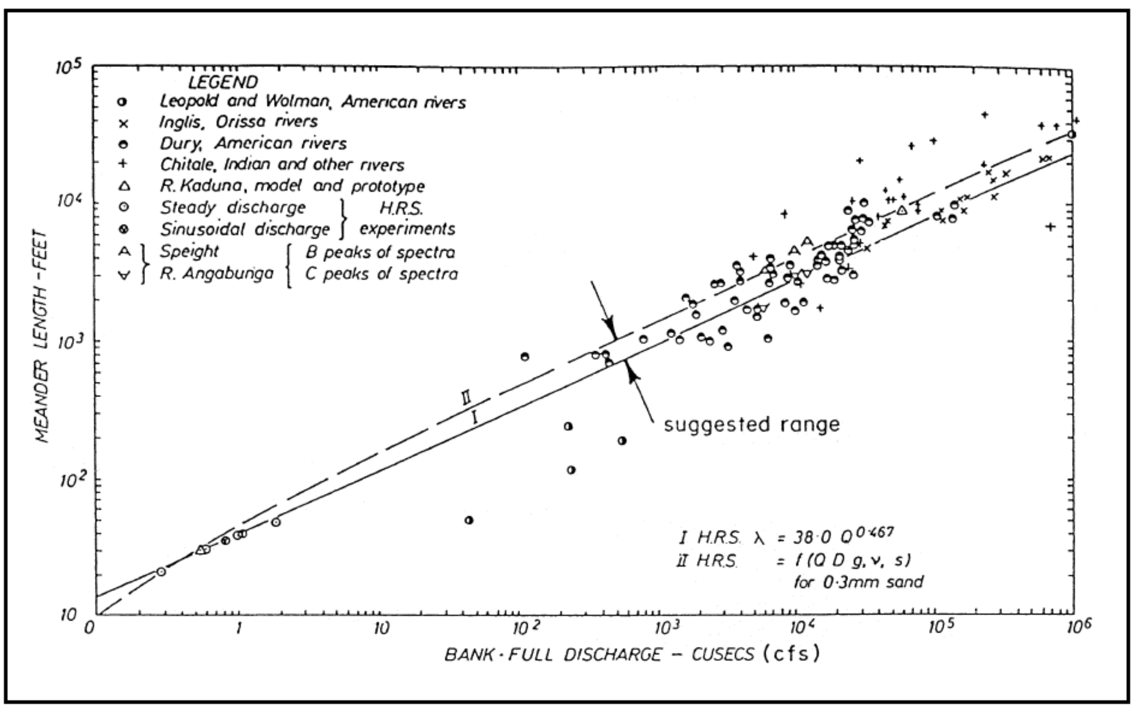


Figure 4. Hydraulic geometry meander wavelength predictor (Ackers and Charlton 1970 - EM 1110-2-1418)

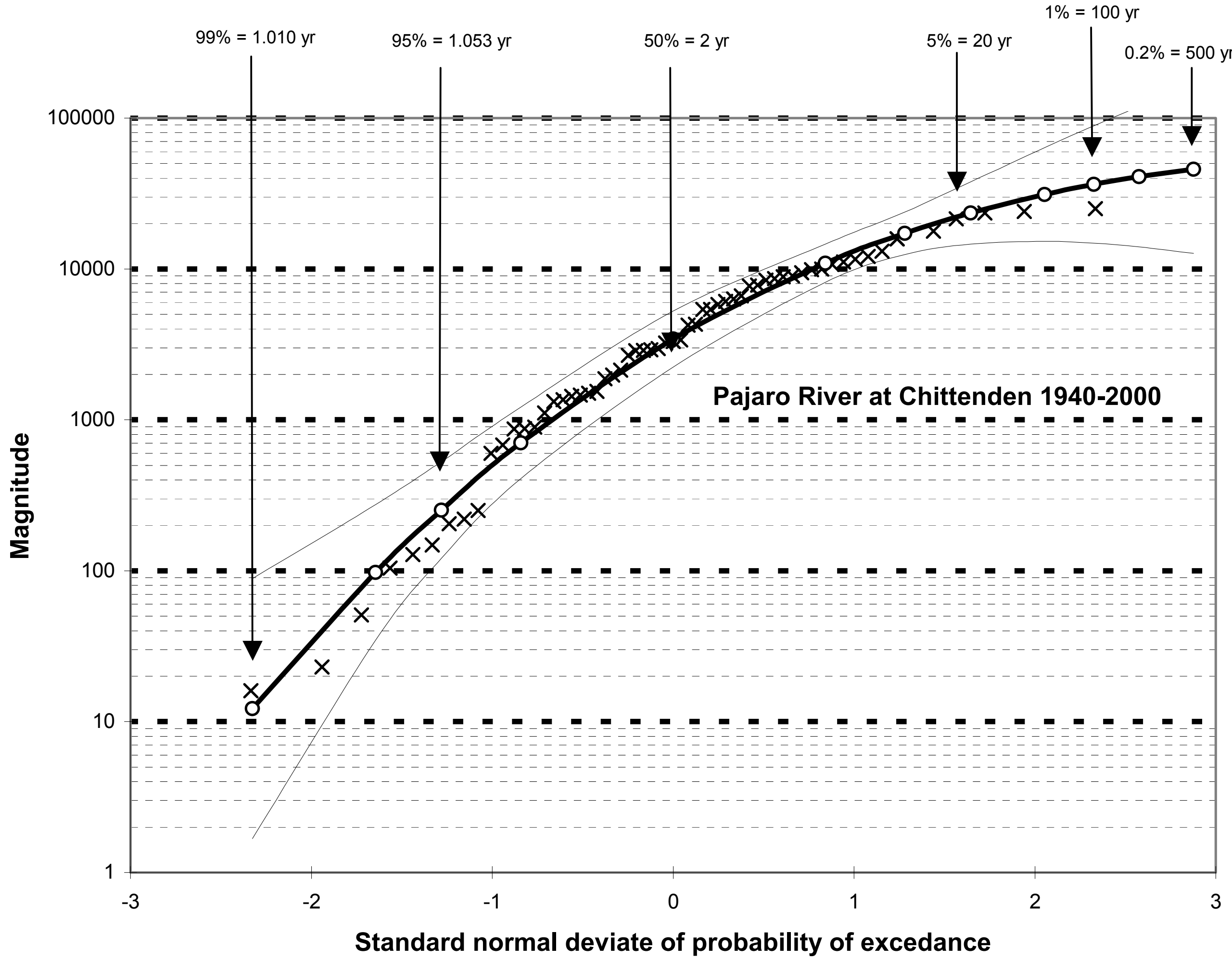


Figure 6: Plot of actual peak floods (X's) versus LogPearson Type III calculated values (open Circles). This is not calculated using the required methodology, as done in Chapter 2.

This Project Report

When the original U.S. Army Engineers flood control project was begun in 1943 and completed in 1948, all 4 counties in the watershed signed off on an agreement to accept responsibility for maintenance of the flood control works in accord with a detailed maintenance plan prepared by the Army (Secretary of War, 1944). In the 1960's the upstream counties, under the organization of Santa Clara County, requested a Congressional exemption from the earlier agreement (Secretary of the Army, 1965), and it was granted. This political context prevented several efforts to develop a watershed-based joint powers authority to manage the watershed after the March, 1995 floods that took one life in Pájaro and caused many millions of dollars of losses in the Lower Valley.

Congressional efforts in response to landowner concerns following the 1995 and 1998 floods lead to appropriations for, and efforts by the Corps' to review and revise the flood control project. Because of the failures of prior efforts to solicit cooperation from upstream counties, it was deemed politically necessary to restrict the scope of flood control efforts to a downstream project that simply rebuilt the original 1948 project within the same reaches of the Lower Pájaro River that had been the subject of structural efforts in the past (Congressman Sam Farr, personal communication).

The current project attempts to rectify the inability of the government efforts to consider solutions that most effectively and economically deal with the river system rather than only the lower river reach. While this is a suitable context for investigation by an academic institution, it also provides a public service outside the context of political limitations of elected and regional persons and bodies. Because the Corps' must complete an environmental impact statement and analysis for their proposed lower river project, the opportunity to think outside of the artificial box can be required through § 102.2.c of the National Environmental Policy Act. This project document seeks to provide some bases for that required analysis.

We approach this task through the following primary foci:

1. An analysis of the design flood magnitude and duration that must be accommodated by any lower river protective works.

2. An assessment of potential opportunities for reducing those flood flows through enhanced upstream flood storage using natural or small-scale structural enhancements that will increase wildlife habitat and amenities for upstream landowners and governments in order to encourage their implementation.

3. Analysis of the unique geologic and hydrologic characteristics of the present configuration of the Pájaro Watershed as they control and limit options for flood hazard reduction.

4. Compilation and preparation of a comprehensive database on the watershed in digital format that can be shared by the 4 counties and the interested public.

Additional analyses for the economic feasibility of combinations of upstream and downstream flood mitigation efforts, the political economic driving forces that need to be acknowledged and accommodated to make a watershed-wide flood control solution work, the roles of federal and state agencies in permitting and regulating effective solutions, and the environmental constraints and restoration opportunities afforded by a watershed-wide flood control project are also woven into the fabric of this report.

Coordination with ongoing work

Raines, Melton & Carella, Inc. (RMC) have been contracted through the Pájaro River Watershed Flood Prevention Authority, formed through coordination of the Association of Monterey Bay Area Governments (AMBAG) to consider opportunities to increase upstream flood storage through modification of existing reservoirs or construction of new flood control dams. Their first report is available through AMBAG and, for a limited time, on their website: http://www.rmcengr.com/Pages/prwfpa.htm (Phase I). RMC conducted standard hydrologic modeling of effects of urbanization in the largely rural upper watershed, and assessed costs of new or rebuilt conventional dams that could provide some flood control benefits. The findings basically demonstrate that build-out in San Benito County has little net effect on countywide and watershed-wide runoff volumes, and that costs for old-style flood control dams exceed benefits. One finding of the initial RMC study became the focus of a concurrent Phase III study looking at the ephemeral Soap Lake wetland area along the upper Pájaro River and lower Llagas and Uvas creeks. RMC concluded that this natural ephemeral basin provided on the order of 30,000 ac-ft of storage and that, without it, flood peaks at Chittenden would increase about 137% for the 100-year event. The RMC Phase II study, also available now, looks at alternatives in the lower valley for bypass and underground floodways and compares them to the various Corps' proposals for levee modification.

Our work also looked at Soap Lake and considered alternatives for enhancing flood storage in a portion of that feature. We did not assume that diminished development pressure or conservation-flood easements could preserve all of the existing occasionally flooded agricultural land, and thus looked at compensating alternatives to allow some levels of development and new highway construction. AMBAG and the Watershed Flood Prevention Authority are exploring flood easements for the core 7900 acres of the site.

Philip Williams and Associates, Ltd. (PWA) were contracted in June of 2003 by the Sierra Club to investigate alternatives not considered by RMC or by the Corps' as publicly revealed to that date. The PWA report, being released simultaneously with this report, considers a series of downstream flood mitigation scenarios and links some of them to opportunities for enhanced upstream flood detention to reduce downstream costs, environmental losses, and maintenance. The PWA studies consider stable channel alternatives as well as constricted high-maintenance channelization options to provide a wider range of alternatives than have been publicly discussed by any entities to date. Among the options considered by PWA is one proposed by state and federal regulatory agencies to regrade the channel to a "self-maintaining" form. It is designed to transport sediment through the system without mechanized assistance, and tries to meet stated goals and objectives of these public agencies that must review and approve any chosen alternative.

U.S. Army, Corps of Engineers (Corps') is the lead agency for the downstream flood control project. The Corps' has been involved repeatedly following the initial project completion immediately after WW II. Their charges include annual monitoring and oversight of levee and channel maintenance, repair and resurvey after the 1989 Loma Prieta Earthquake and the 1995 and 1998 floods, and design and construction oversight of any new flood control project that modifies or replaces their original project. City and County governments and citizens have nearly continuously requested intervention and design improvements for the Corps' projects that protect the City of Watsonville and the lower Pájaro flood channel. As was revealed in the 1997 trial of CalTrans for ponding of flood waters associated with the 1995 floods, the State of California had always assumed that the Corps' had responsibility for 100-year flood protection for the entire Pájaro Valley and, thus, that highways crossing that valley at its lowest point need not accommodate any but local rainfall runoff beneath the highway berm. The Corps' has held repeated public informational meeting and tried to use a "stakeholder" process to consider concerns of the lower Pájaro River communities. A very considerable effort was initiated in 1998 by the Corps' to critically review past and anticipated future activities of the agency using a nationwide in-house professional team (United States Army, Corps of Engineers, 1998), but the public has not seem much response from the Corps' to that foundation report. The agency will again attempt to provide a series of alternatives and choose one for final preferred evaluation during July 2003.